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ABSTRACT

Noting that the progressive aging of the American population has created a need for a body of knowledge about the vocal characteristics associated with aging, this paper provides information on geriatric voice. The first section of the paper contains a selected bibliography of materials concerning geriatric voice, including literature on the need for research on how aging affects the voice; the physiological changes that produce voice changes; the perceived characteristics of the geriatric voice, such as slow rate, imprecise articulation, hoarseness, and laryngeal tension; and the objective measurement of the aged voice. The second section briefly describes an original research project on the geriatric voice that has implications for communication specialists. This section discusses the methodology used to collect data about the vocal characteristics of 20 young adults and 20 older adults. It also reports the results of the research, indicating what speech characteristics changed over time and how the objective measures used could apply to the diagnosis of abnormalities in the geriatric voice. (RL)

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# IMPLICATIONS OF RESEARCH ON THE GERIATRIC VOICE

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THE GERIATRIC VOICE:

RESEARCH AND IMPLICATIONS

There are two sections in this paper. The first section consists of a selected bibliography of research concerning geriatric voice. The second section briefly presents results of original research on the geriatric voice and the implications of voice for communication specialists.

## PART I: REVIEW OF THE LITERATURE

The following is a selected bibliography of the literature on aging voice. The bibliography concerns the need for communication research, the physiological changes which result from the aging process, the perceived characteristics of voice, and objective measurement of the aged voice.

### Communication and Need

General works concerning the need for research in the area of geriatric communication are listed below. With the greying of the American population, basic research on the voice of the normal geriatric is necessary. Research in a few areas is available, but normative data on the many aspects of voice in the normal elderly person is lacking.

Bollinger, R. L. "Geriatric Speech Pathology," The Gerontologist, 14, 217-220 (1974).

Cooper, M. "Voice Problems of the Geriatric Patient," Geriatrics, 25, 107-110 (1970).

Meyerson, M. D. "The Effects pf Aging on Communication," Journal of Gerontology, 31, 29-38 (1976).

Oyer, H. J. and Oyer, E. J. Aging and Communication. Baltimore: University Park Press, 1976.

Pettas, M. "An Exploratory Study of Oral Communication Characteristics in a Population of Aged Women," unpublished Doctor's Dissertation, University of Florida, 1963.

Schow, R. L., Cristensen, J. M., Hutchinson, J. M., and Nerbonne, M. A. Communication Disorders of the Aged: A Guide for Health Professionals. Baltimore: University Park Press, 1978.

Subcommittee on Human Communication and Its Disorders. Human Communication and Its Disorders: An Overview. Washington, D. C.: National Institute of Neurological Disease and Stroke, 1970.

Wilder, C. N. "Vocal Aging," in B. Weinberg (ed.), Transcripts of the Seventh Symposium: Care of the Professional Voice: Part II: Life Span Changes in the Human Voice. New York: The Voice Foundation, 1978.

## Physiological Changes

As people age, general changes in anatomy and physiology result. Changes in laryngeal structure as well as the respiratory and articulatory systems occur. Although the rate of these changes differs among individuals, ossicification and calcification of the laryngeal cartilages occurs, the tissues are less elastic, the mucosa becomes thin, and the vocal fold muscles atrophy. The overall result is a reduction in the total range of functioning.

Balogh, K. and Lelkes, K. "The Tongue in Old Age," Gerontological Clinica, 3, supplement, 38-54 (1961).

Blonsky, E. R., Logemann, J. A., Boshes, B., and Fisher, H. B. "Comparison of Speech and Swallowing Function in Patients with Tremor Disorders and in Normal Geriatric Patients: A Cinefluorographic Study," Journal of Gerontology, 30, 299-303 (1975).

Jackson, C. and Jackson, C. L. Larynx and Its Diseases. Philadephia: W. B. Saunders, 1937.

Luchsinger, R. and Arnold, G. T. Voice-Speech-Language. Belmont, California: Wadsworth Publishing Company, 1965.

Pressman, J. J. and Keleman, G. Physiology of the Larynx, revised by J. A. Kirchner. Rochester, Minnesota: American Academy of Ophthalmology and Otolaryngology, 1970.

Schock, N. W. "Age Changes in Some Physiologic Processes," Geriatrics, 12, 40-48 (1957).

Wolff, K. The Biological, Sociological, and Psychological Aspects of Aging. Westport, Connecticut: Greenwood Press, Publishers, 1978.

## Perceptual Characteristics

Studies have established that the sound of a person's voice is sufficient for listeners to estimate the speaker's age. In addition, research indicates that certain characteristics such as slow rate, imprecise articulation, hoarseness, and laryngeal tension have been perceived as characteristic of older voices.

Burk, K. W., Hoyer, E. A., and Fey, M. "Perceptual and Acoustic Correlates of Aging in the Female Voice," paper presented at the American Speech-Language-Hearing Association Convention, Washington, D.C., 1975.

Hartman, D. E. and Danhauer, J. L. "Perceptual Features of Speech for Males in Four Perceived Age Decades," Journal of the Acoustical Society of America, 59, 713-715 (1976).

Horii, Y. and Ryan, W. J. "Fundamental Frequency Characteristics and Perceived Age of Adult Male Speakers," Journal of the Acoustical Society of America, 57, abstract, 569 (1975).

Kukol, R. J. "Perceptual Speech and Voice Characteristics of Aging Male and Female Speakers," unpublished Doctor's Dissertation, Wichita State University, 1979.

Ptacek, P. H. and Sander, E. K. "Age Recognition from Voice," Journal of Speech and Hearing Research, 9, 273-277 (1966).

Ryan, W. J. and Burk, K. W. "Perceptual and Acoustic Correlates of Aging in the Speech of Males," Journal of Communication Disorders, 7, 181-192 (1974).

Shipp, T. and Hollien, H. "Perception of the Aging Male Voice," Journal of Speech and Hearing Research, 12, 703-710 (1969).

## Objective Measures

Research involving objective measures of certain respiratory, laryngeal, and articulatory characteristics of the geriatric population are identified below. In general, studies of the respiratory functioning of the elderly show reduced vital capacity, reduced air flow, and reduced air volumes. The effect of the respiratory reductions on speech is questionable. Studies concerning laryngeal function of geriatric voices have tended to focus upon frequency characteristics. Although a general increase in fundamental frequency for older males and a slight decrease in fundamental frequency of older females is considered normal, the results of frequency variation measures of older speech are not as clear cut. Physiological changes in articulatory structure have been identified and perceived imprecision of articulation has been noted, but exploration of articulation characteristics of the elderly has been limited to studies of speech or reading rate.

Charlip, W. S. "The Aging Female Voice: Selected Fundamental Frequency Characteristics and Listener Judgments," unpublished Doctor's Dissertation, Purdue University, 1968.

Endres, W., Bambach, W., and Flosser, G. "Voice Spectrographs as a Function of Age, Voice Disguise, and Voice Imitation," Journal of the Acoustical Society of America, 49, 1842-1848 (1971).

Ericsson, P. and Irnell, L. "Spirometric Studies of Ventilation Capacity in Elderly People," Acta Medica Scandinavia, 185, 179 (1969).

Hollien, H. and Shipp, T. "Speaking Fundamental Frequency and Chronologic Age in Males," Journal of Speech and Hearing Research, 15, 155-159 (1972).

Hutchinson, J. M., Robinson, K. L. and Nerbonne, M. A. "Patterns of Nasalance in a Sample of Normal Gerontological Subjects," Journal of Communication Disorders, 11, 469-481 (1978).

McGlone, R. and Hollien, H. "Vocal Pitch Characteristics of Aged Women," Journal of Speech and Hearing Research, 6, 164-170 (1963).

Mysak, E. D. "Pitch Duration Characteristics of Older Males," Journal of Speech and Hearing Research, 2, 46-54 (1959).

Ptacek, P. H., Sander, E. K., Maloney, W. H., and Jackson, C. "Phonatory and Related Chages with Advanced Age," Journal of Speech and Hearing Research, 9, 353-360 (1966).

Ryan, W. J. "Acoustic Aspects of the Aging Voice," Journal of Gerontology, 27, 265-268 (1972).

Saxman, J. and Burk, K. "Speaking Fundamental Frequency Characteristics of Middle Aged Females," Folia Phoniatrica, 19, 167-172 (1967).

Scholl, H. H. "Comparisons of Voice between Young College Women and their Mothers," unpublished Doctor's Dissertation, Columbia University, 1959.

Wilcox, K. A. and Horii, Y. "Age and Changes in Vocal Jitter," Journal of Gerontology, 2, 194-198 (1980).

## PART II: ORIGINAL RESEARCH ON GERIATRIC VOICE

As the population becomes progressively older, it is increasingly important to develop a body of knowledge about vocal characteristics associated with aging. Anatomical and physiological changes associated with aging affect communication ability. While the majority of the elderly are self-sufficient, even the independent elderly person is affected by the normal aging process. Advancing age tends to restrict activities and the elderly individual becomes more reliant on communication abilities at the same time his/her speech mechanism begins to deteriorate.

Although there have been many studies of pathological conditions which affect the elderly, there is little data about normal older voices. The present study objectively measured the normal aged voice and compared the aged voice with young adult voice on multiple objective and perceptual measures. The resulting global assessment of the geriatric voice may be used as normative data and many also be used as a reference for diagnosis of pathological conditions.

This paper highlights the need for closer workings of the speech scientist with the speech-communication specialist. While the communication specialist is concerned with the overall communicative function of the individual, the speech scientist provides the necessary objective description of the normal aged voice. The speech-communication specialist must be aware of the normal aspects of geriatric voice so inappropiate referrals will not be made. It is the speech scientist who provides much of the description upon which the communication specialist relies. Both speech scientists and communication specialists must contribute to the diagnosis of speech-communication disorders of the geriatric population.

## Method

Twenty males and females aged 21 to 32 years with an average age of 29.4 years and twenty males and females aged 68 to 82 years with a mean age of 74.0 years served as subjects. Subjects were nonsmokers who demonstrated normal hearing for their ages and had no known pathological conditions.

Subjects were asked to read a standardized passage and recordings of their voices were made in a sound-treated room. Electrodes from an electro-laryngograph were attached to the subjects' throat to display the movement of the vocal folds. The volume of air expired while producing syllables was also measured.

The data about the perceived characteristics of the voices were obtained by judges' ratings of the voices on a prepared scale. The scale rated ten vocal characteristics: hypervalving, hypovalving, pitch, pitch variability, laryngeal tension, imprecise articulation, intensity, nasality, rate of speech and rate of articulation.

The older voices were compared to young adult voices on characteristics of vocal fold movement obtained from the electrolaryngograph waveform and on each of the ten perceptual characteristics. In addition, the voices were compared on objective measures of frequency (i.e., fundamental frequency, range of frequency in speaking, number of inflections, and maximum inflection in a 100 msec. period), intensity, spectrographic measures (i.e., length of speech segment, formant frequency, vocie onset time), as well as rate measurements (i.e., number of syllables per second, number and length of pauses, and articulation rate). Finally, all perceptual and objective measures were correlated with subject age.

## Results and Discussion

The present study provides a multiple measure description of the geriatric voice and compares the geriatric and young adult voice on these measures. Both perceptual and objective measures were used in this global assessment of the acoustical, aerodynamic, and perceptual characteristics in the geriatric voice.

The results of the study indicate that older women are perceived as having a laryngeal component to their vocal efforts while older males display an imprecise articulatory component. Consequently, strain, softness, and tremor might be normal in the voice of an older female while articulatory imprecision is found in the older male voice. Speech disorders should be suspected when the voice of an older male shows hyperfunctioning or tension and older females with imprecise articulation may be suffering from a dysarthric aspect not normally associated with older female articulation.

The results of the objective measures can be related to the anatomic and physiological changes which result with age. The larynx, the respiratory

system, and articulation are all affected. For instance, the expected atrophy and thinning of the vocal folds could account for the major irregularities found in the older subjects' electrolaryngographic waveforms of adductory vocal fold movement, in excessive air loss by older males, and in reduced voice onset times in the articulatory characteristics of older subjects.

The correlations between the perceptual and objective factors of this study with the age of the subject yielded significant results. The perceptual characteristics of increased hypervalving, vocal tremor and imprecise articulation were significantly correlated with age while increased loudness and rate were negatively correlated with age. Several objective factors of frequency and articulation length were positively correlated with age (increased pitch variability and several increased articulatory segment durations) while increased vital capacity, voice onset time, and several rate of speech measurements were negatively correlated with age.

Not only were these factors correlated with age, but there were significant difference between the young adult voices and the nonpathological elderly voices on these objective measures. Older subjects used significantly greater pitch ranges in reading and significantly greater number and extent of inflection than the young adult subjects. Not only did the older speakers produced significantly shorter voice onset times than the younger speakers, but the older speakers elongated vowels and produced fewer syllables per second. These objective measures indicated increased pitch variability and slow articulatory or speech rates.

Many of the objective measures can be used to provide normative data on which diagnosis of pathological conditions in the geriatric patient can be made. The present study found an increase in the extent of maximum

inflection in the older voices. Previous studies had found a reduction in the maximum inflection in the voice of patients with laryngeal pathologies. Since the maximum inflection produced by the older subjects in this study was increased, any reduction of maximum inflection should be investigated further since this reduction of inflection does not occur in normal aging.

Extended pitch range and an increase in the number of inflections was also found to be significantly increased in the older speakers. Consequently, monotone or other reductions of pitch variability should be considered abnormal in the voices of the elderly. Such restriction of flexibility into the speaking range should be further investigated by the specialist.

This paper has attempted to provide a brief description of the voice of the nonpathological elderly. Knowledge of the normal and abnormal functioning of the aged voice provides the basis for appropriate therapy and/or referral. This information is valuable to the communication specialist when working with the geriatric population.